Matrix Project

EE-1390

Sunny Manne   Aditya Singh
MS18BTECH11015   CS18BTECH11048

February 14, 2019

If an equilateral triangle, having centroid at the origin, has a side along the line $x + y = 2$, then find the area of this triangle.

Matrix Transformation

- A line can be written in the form

$$\mathbf{n} \cdot (\mathbf{r} - \mathbf{a}) = 0$$

- where $\mathbf{n}$ is normal vector, $\mathbf{r}$ is position vector of points on the line, and $\mathbf{a}$ is position vector of any known point lying on the line

Matrix Transformation
contd...

- In our case $\mathbf{n}$ is $(\ 1\quad 1\ )$ and $\mathbf{r}$ is $\left(\begin{array}{c} x \\ y \end{array}\right)$

- and $\mathbf{n} \cdot \mathbf{a} = 2$

- hence equation in terms of matrix is: $(\ 1\quad 1\ ) \cdot \mathbf{r} = 2$

Solution in terms of Matrix

- let the centroid(origin) be G = (0   0),
  and the point of intersection of median with given base be X

- To find X following system of equation needs to be solved:
  $\mathbf{n1} \cdot \mathbf{r} = \mathbf{n1} \cdot \mathbf{a}$ and
  $\mathbf{n2} \cdot \mathbf{r} = \mathbf{n2} \cdot \mathbf{G}$

- where $\mathbf{n1} = (\ 1 \quad 1 \ )$, and
  $\mathbf{n2} = (\begin{smallmatrix} 0 & -1 \\ 1 & 0 \end{smallmatrix})(\ 1 \quad 1 \ )^T$

- Therefore the sysytem of the equation can be written as:
  X = inv(N)*C

- Here N = $\begin{pmatrix} \mathbf{n1} \\ \mathbf{n2} \end{pmatrix}$ or $N = \begin{pmatrix} 1 & 1 \\ 1 & -1 \end{pmatrix}$
  , and

- Here C = $\begin{pmatrix} \mathbf{n1} \cdot \mathbf{a} \\ \mathbf{n2} \cdot \mathbf{G} \end{pmatrix}$ or $C = \begin{pmatrix} 2 \\ 0 \end{pmatrix}$

- solving the equations we get X = $\begin{pmatrix} 1 \\ 1 \end{pmatrix}$

Graph